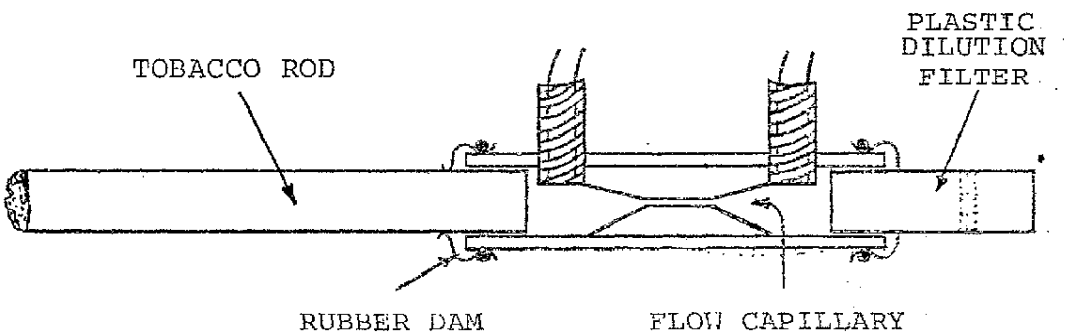
CONFIDENTIAL

TO: R. B. Seligman DATE: July 28, 1967

FROM: W. L. Dunn, Jr.

SUBJECT: A Study of the Effect of Lip Occlusion of Air Holes on Main Stream Delivery in Air Diluted Cigarettes

An earlier study (Memo of June 27, 1967) established that lip contact with the tipping paper extended to 9.96 mm from the outer end of the tipping paper for the average smoker. Since the air dilution holes are located in a band from 8.0 to 9.7 mm from the outer end of the tipping paper, it follows that some of these holes are likely to be occluded under normal smoking conditions, whereas no occlusion is likely to occur when the cigarettes are machine smoked for analysis. Does this then



mean that the smoker can be expected to obtain more mainstream smoke than indicated from the analytical data? We designed a study to answer this question.

We reasoned that if there is an increase in the mainstream component of the smoke as a result of lip occlusion, the increase would be reflected in the difference in mainstream volume between an air diluted cigarette where normal lip occlusion can occur and the same cigarette where lip occlusion can not occur. One would expect an increase in mainstream volume when dilution air is reduced by lip occlusion.

We were concerned only with the effect of lip occlusion upon mainstream volume when normally smoking the air dilution cigarette with a 10 mm plastic sleeve. Therefore, no attempt was made to systematically occlude. We simply measured mainstream volume under conditions which permitted normal occlusion and under conditions which did not permit normal occlusion.

Measurements were made by inserting a flow rate transducer between the tobacco rod and the filter tip. The transducer signal was fed into an amplifier with two outputs. One output was fed into a polygraph recorder. This provided a graphic recording of flow rate with time. The area under the curve generated by a puff represented puff volume. The second output from the amplifier was delivered to an electronic integrator which yielded a direct puff volume reading in cc's on an electronic counter. This reading was recorded manually by the operator. The instruments were screened from the smoker's view. That portion of the assembly seen by the smoker is shown diagrammatically.

The chamber fed air pressure readings into two transducers, only one of which provided readings for this study.

All available regular Richmond panelists participated, yielding a gross total N of 52. The records of seven subjects were rejected as unuseable, leaving a net N of 45 subjects. Each panelist smoked on two successive days, one cigarette per day.

The two samples of cigarettes were drawn from a common lot of 85 mm cigarettes with air dilution filters, plastic type. Cigarette 1 was smoked with no modification other than transducer chamber insertion. Cigarette 2 was additionally modified by attaching a 10 mm extension sleeve of Parliament-like tipping paper to the mouth end of the filter. An ink band was inscribed on the rod paper 35 mm from the coal end.

Subjects were instructed to smoke to the mark on the paper. They were told that the purpose of the study was to evaluate the flavor and acceptability of the smoke, and that the purpose of the inserted chamber and recording equipment was to measure a certain component of the smoke. Presentation order was balanced. Acceptability ratings were obtained on each cigarette.

The results are tabulated below. The number of puffs recorded are the total number minus lighting puffs. Lighting puffs were readily identifiable as such by inspection of the patterning of the polygraph recordings. Total mainstream volume figures do not include lighting puff volumes.

Note that the tabled values are mainstream values; the gross puff volume would consist of the mainstream volume plus that air volume entering through the dilution holes. The gross puff volume was not measured.

		Mean Mainstream Volume Per Cig. (cc)	Mean Number of Puffs Per Cig.	Mean Mean Puff Mainstream Volume (cc)
Cig. #1 (Without Extension Sleeve)	Mean	425.9	11.00	38.72
	Standard Error	28.5	.49	-
Cig. #2 (With Extension Sleeve)	Mean	454.8	11.76	38.67
	Standard Error	32.00	.56	-

The critical values are entered under the heading "Mean Mean Puff Mainstream Volume". This value was obtained by first determining the mean puff mainstream volume for each subject on each cigarette, then determining the average value for all subjects on each of the two forms of the cigarette. Had the hypothesis been supported that lip occlusion increases mainstream volume, then the mean mean puff mainstream volume would have been higher for Cig. 1 than Cig. 2. Such obviously is not the case. Where considered necessary the values have been included for the standard error of the mean. The differences between columnar means are well within chance expectancy limits in all three instances.

We interpret these findings to mean that the mainstream puff volume is not influenced by whatever occlusion of air holes that occur under normal smoking conditions. There is no reason to suspect that "lipping behavior" under these test conditions differed from normal lipping behavior.

Two explanations of mainstream volume constancy have been put forth by those evaluating these findings:

(1) Smokers adjust puff intake in order to maintain TPM and/or nicotine constancy;

(2) Occlusion of the air holes does not linearly reduce air dilution, thus, up to an undetermined point, the blocking of holes will result in increased compensating flow through the remaining unblocked holes.

Both of these possibilities should be subjected to further study. SEF will assume responsibility for checking out #1. We suggest that #2 be pursued by Jerry Osmalov.

/jem

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